CTIPe Auroral Drivers

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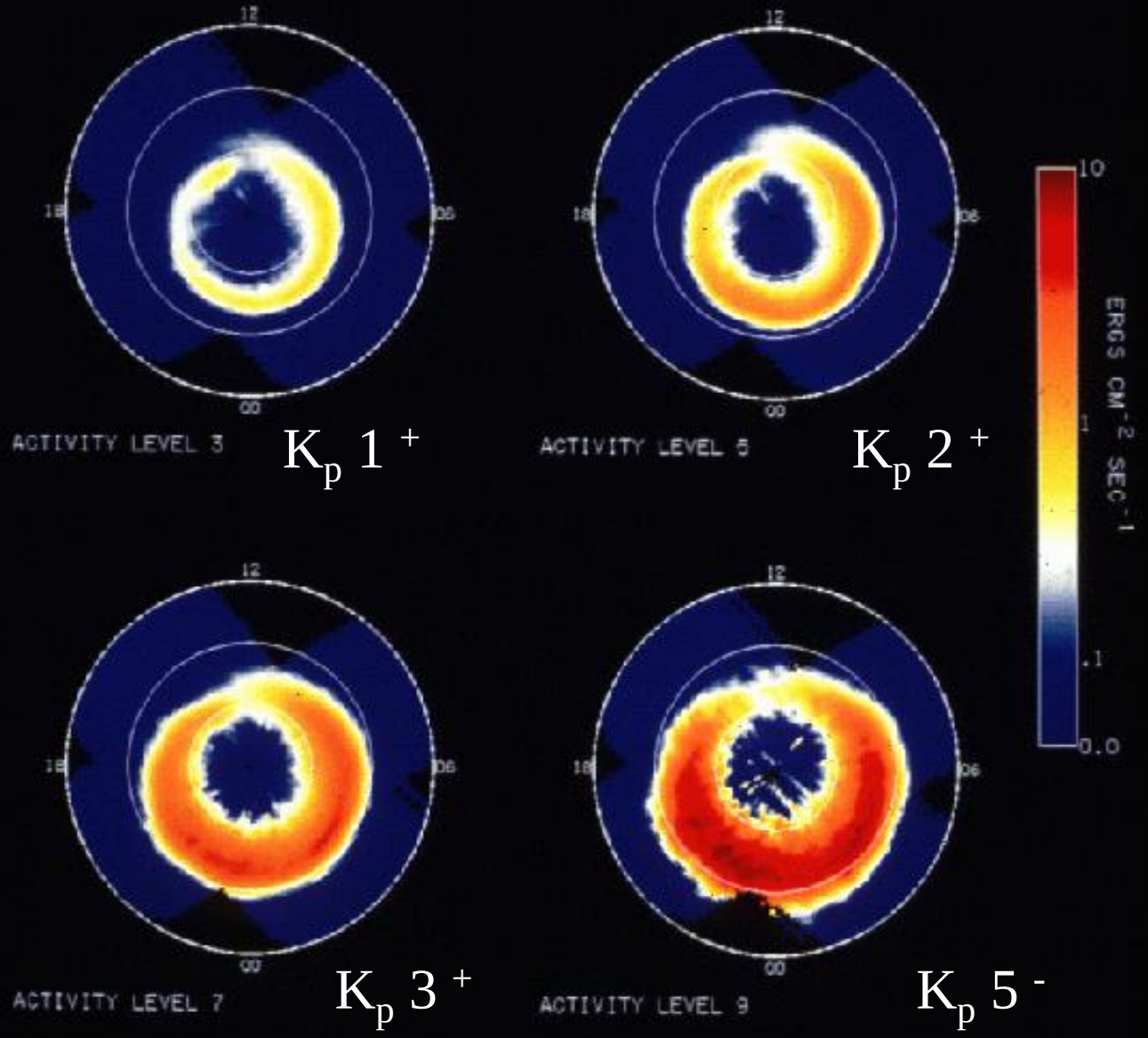
- CTIPe physics-based model magnetospheric inputs are based on the statistical models of auroral precipitation and electric fields described by Fuller-Rowell and Evans [1987] and Weimer [2005], respectively.
- The auroral precipitation is keyed to the hemispheric power index (PI), based on the TIROS/NOAA auroral particle measurements.
- The PI index runs from 1 to 10 to cover very quiet to storm levels of geomagnetic activity; the relationship between PI and Kp is described by Foster et al. [1986].
- TIROS maps of energy influx and characteristic energy, and HP index are used to prescribe ionization and heating rates in CTIPe model.
- The Weimer electric field model is keyed to the solar wind parameters impinging the Earth's magnetosphere. The input drivers include the magnitude of the interplanetary magnetic field (IMF) in the y-z plane, together with the velocity and density of the solar wind.
- Weimer 2005 model accommodates a realistic saturation of the magnetospheric potential for high solar wind velocities and magnetic field.

TIROS/NOAA Auroral Observations Evans et al.

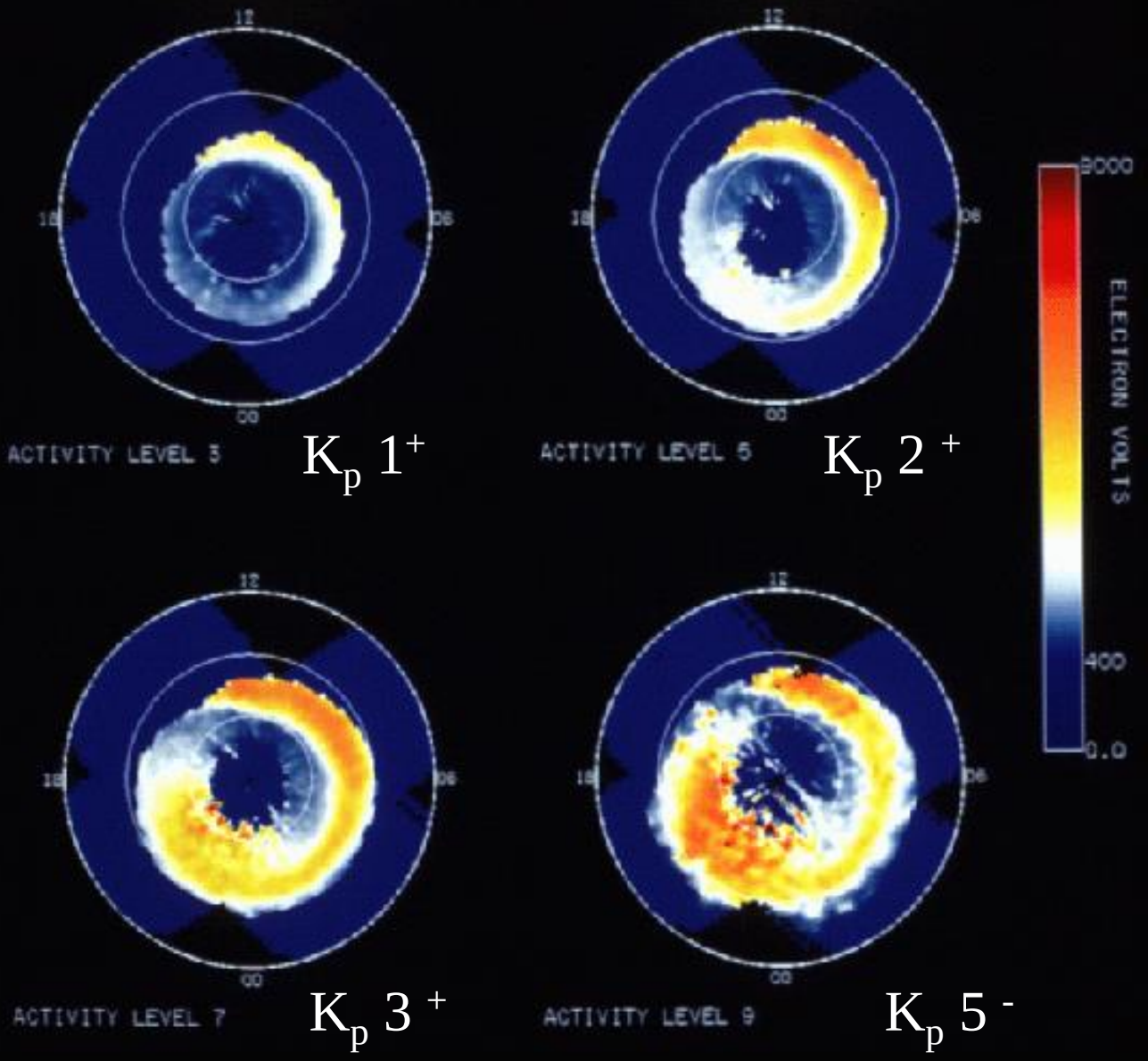
- Measures auroral electron and proton precipitation between 300ev and 100 keV at two pitch angles in loss cone
- Over 30 years of nearly continuous observations
- Polar orbit builds up complete coverage over time
- Statistical patterns of energy influx assembled sorted by internally consistent index - 10 levels of auroral activity
- Auroral power index derived for every polar pass
- Statistical relationship between power index and a_p or K_p

  Auroral Power $= -2.78 + 9.33\ K_p$ Corr. Coeff 0.75

Patterns of auroral particle energy influx



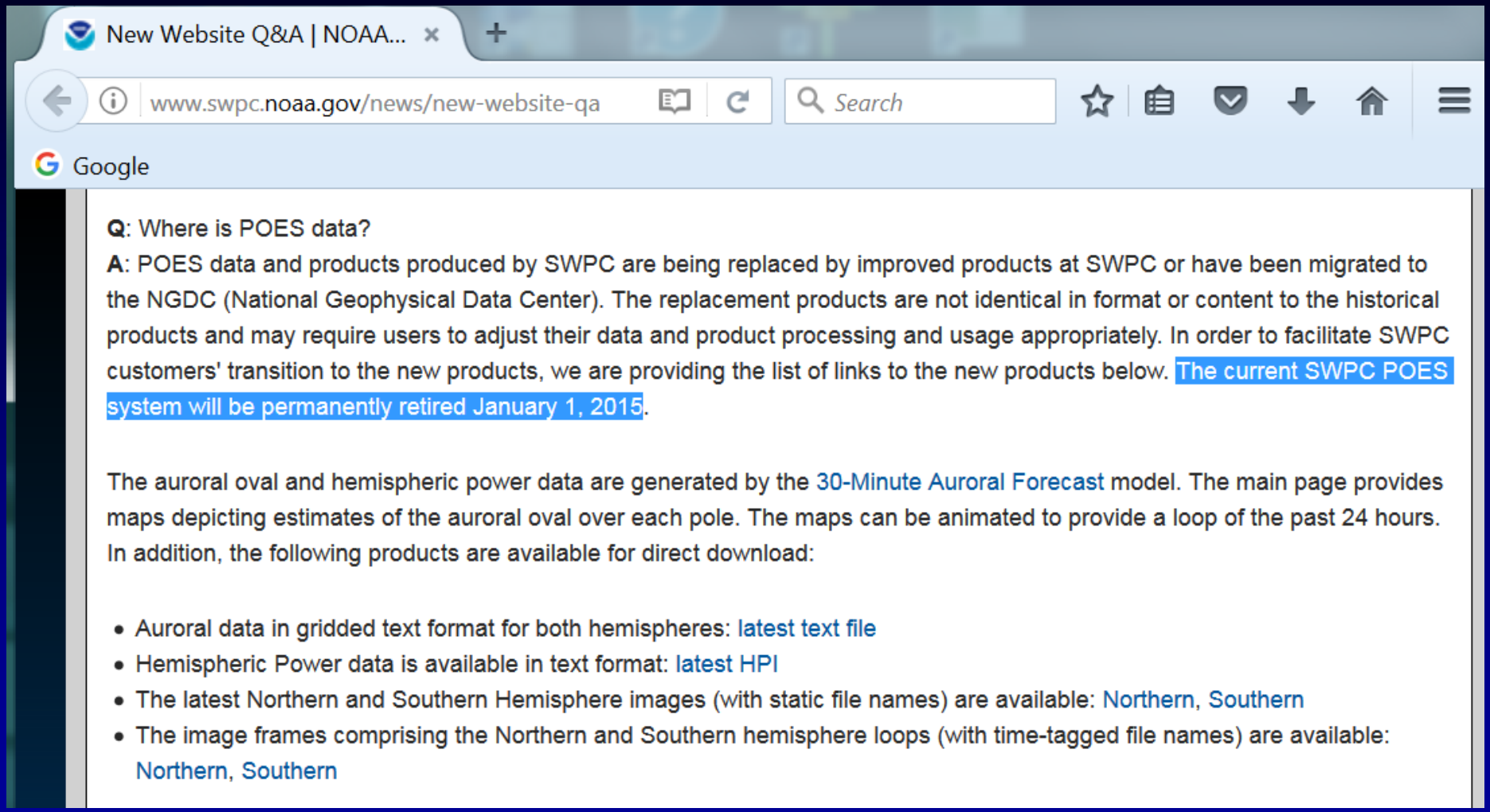
Patterns of characteristic energy of auroral electrons



Relationship between PI and Kp Foster et al. [1986]

TABLE 1. Precipitation Activity Index

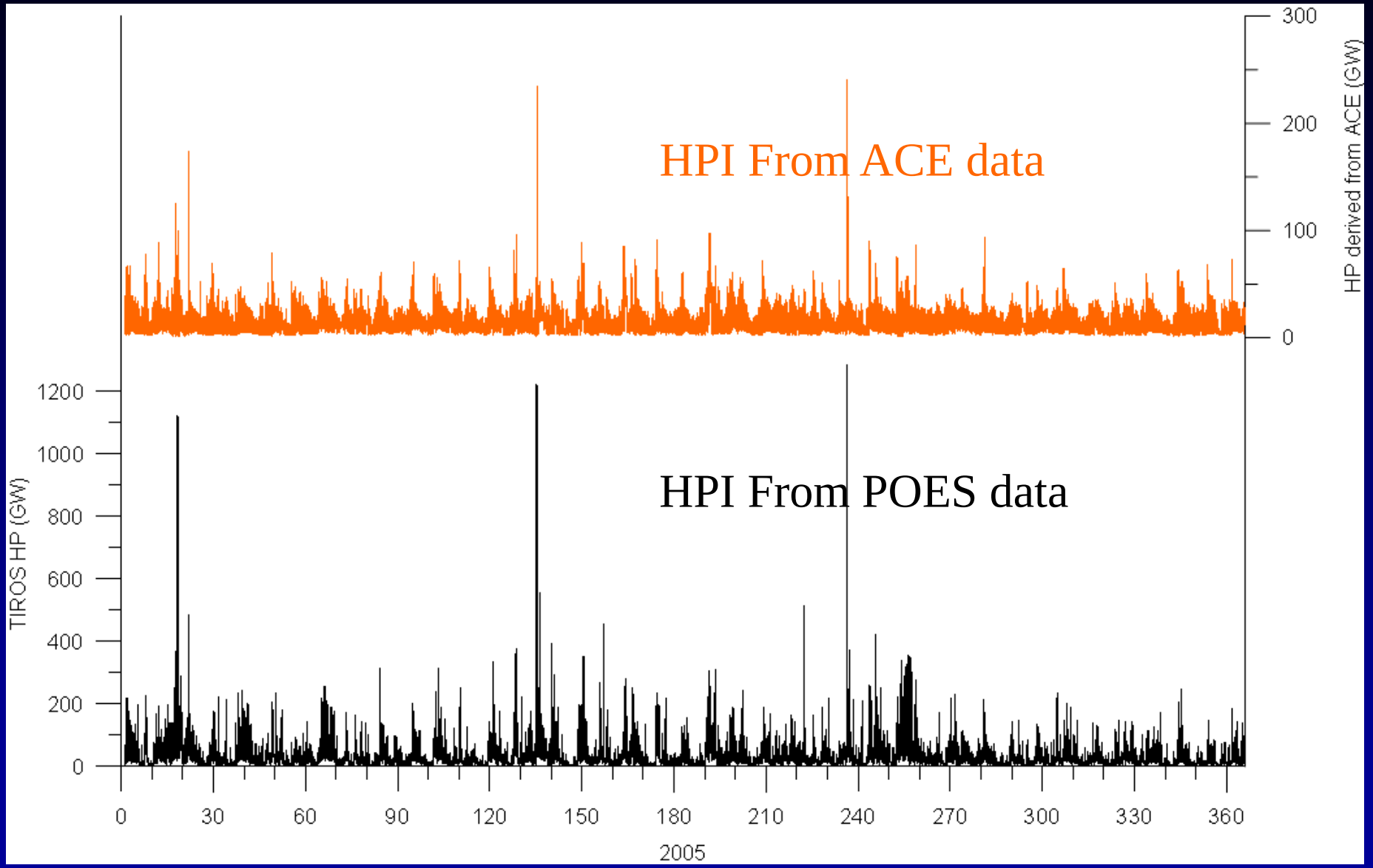
Index	Power Input GW	Polar Cap Potential	Average Kp	Percent Occurrence
1	1.7	13	1-	3.2
2	3.0	14	1o	6.4
3	4.6	26	1+	9.8
4	7.4	32	2-	15.5
5	11.7	36	2+	18.9
6	18.7	46	3-	21.3
7	29.3	53	3+	13.0
8	45.4	57	4o	7.7
9	69.5	79	5-	3.1
10	>96.0	--	6-	1.0

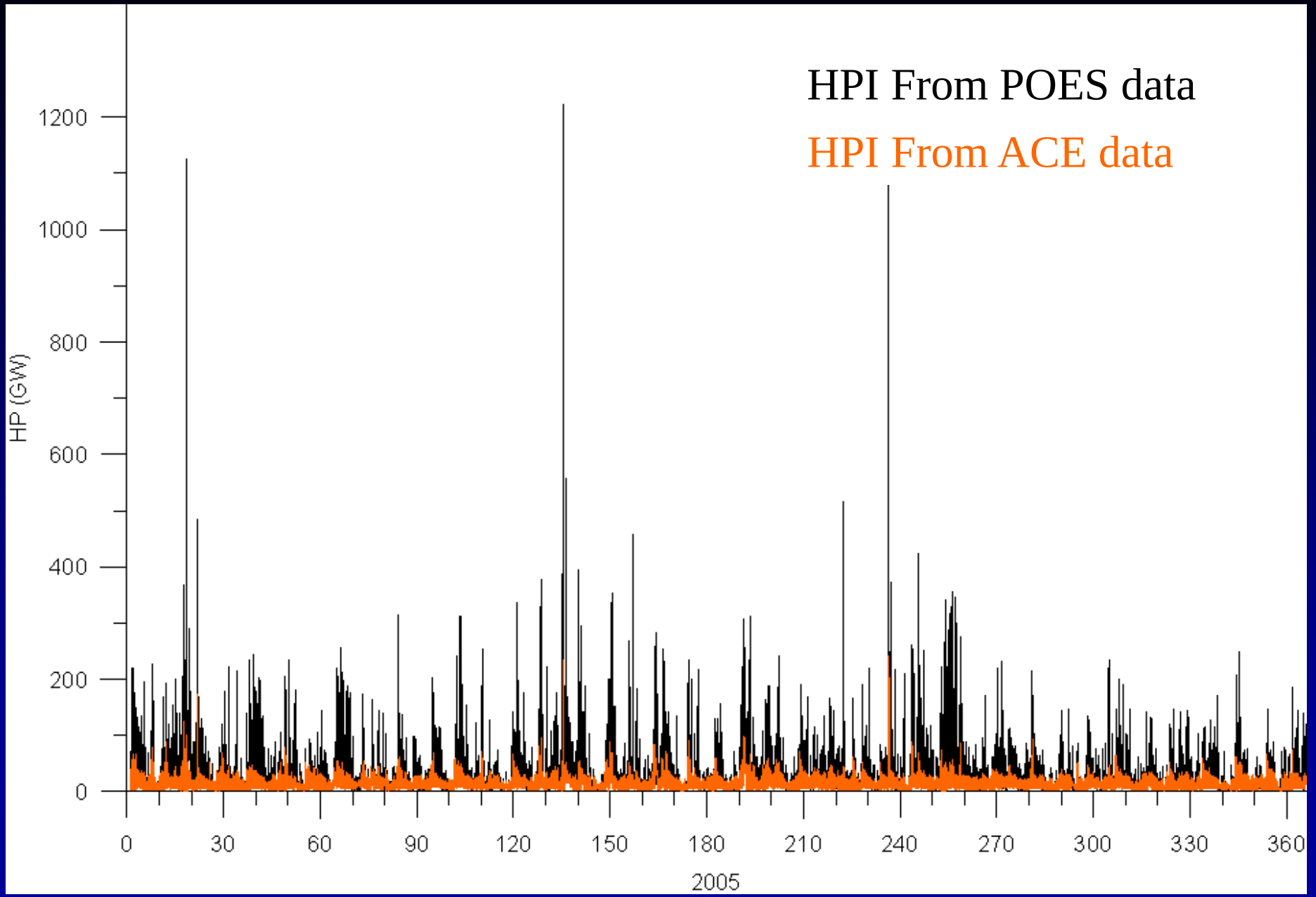


Q: Where is POES data?
A: POES data and products produced by SWPC are being replaced by improved products at SWPC or have been migrated to the NGDC (National Geophysical Data Center). The replacement products are not identical in format or content to the historical products and may require users to adjust their data and product processing and usage appropriately. In order to facilitate SWPC customers' transition to the new products, we are providing the list of links to the new products below. The current SWPC POES system will be permanently retired January 1, 2015.

The auroral oval and hemispheric power data are generated by the 30-Minute Auroral Forecast model. The main page provides maps depicting estimates of the auroral oval over each pole. The maps can be animated to provide a loop of the past 24 hours. In addition, the following products are available for direct download:

- Auroral data in gridded text format for both hemispheres: latest text file
- Hemispheric Power data is available in text format: latest HPI
- The latest Northern and Southern Hemisphere images (with static file names) are available: Northern, Southern
- The image frames comprising the Northern and Southern hemisphere loops (with time-tagged file names) are available: Northern, Southern


HPI From ACE data
HPI From POES data
HP derived from ACE (GW)
TIROS HP (GW)
300
200
100
0
1200
1000
800
600
400
200
0
0
30
60
90
120
150
180
210
240
270
300
330
360
2005


HPI From POES data
HPI From ACE data
HP (GW)
1200
1000
800
600
400
200
0
0
30
60
90
120
150
180
210
240
270
300
330
360
2005

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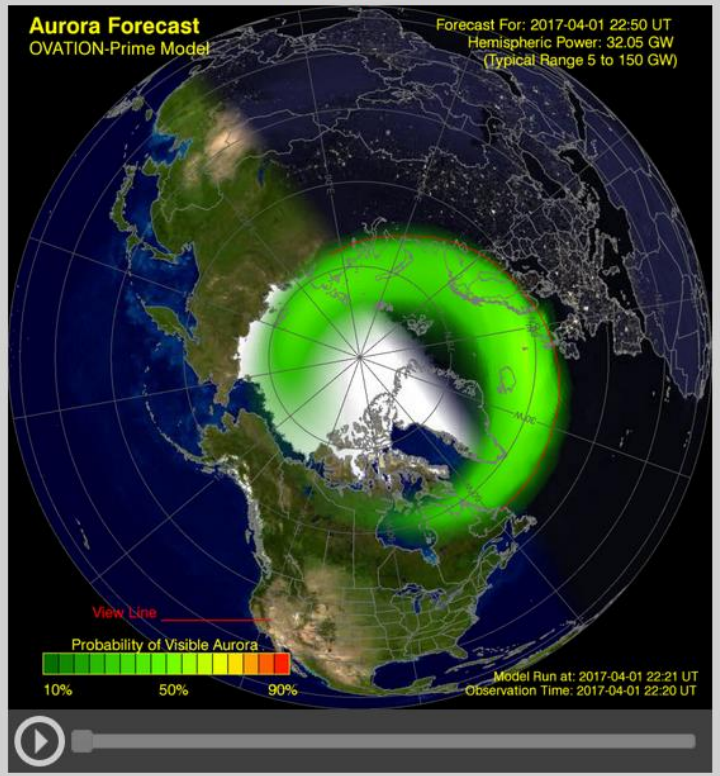
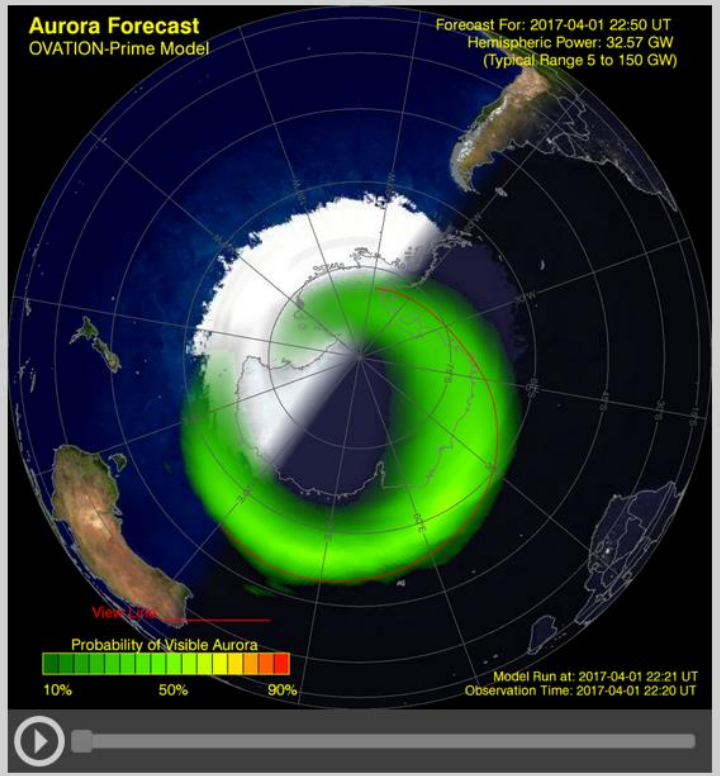
AURORA - 30 MINUTE FORECAST

NORTHERN HEMISPHERE



SOUTHERN HEMISPHERE



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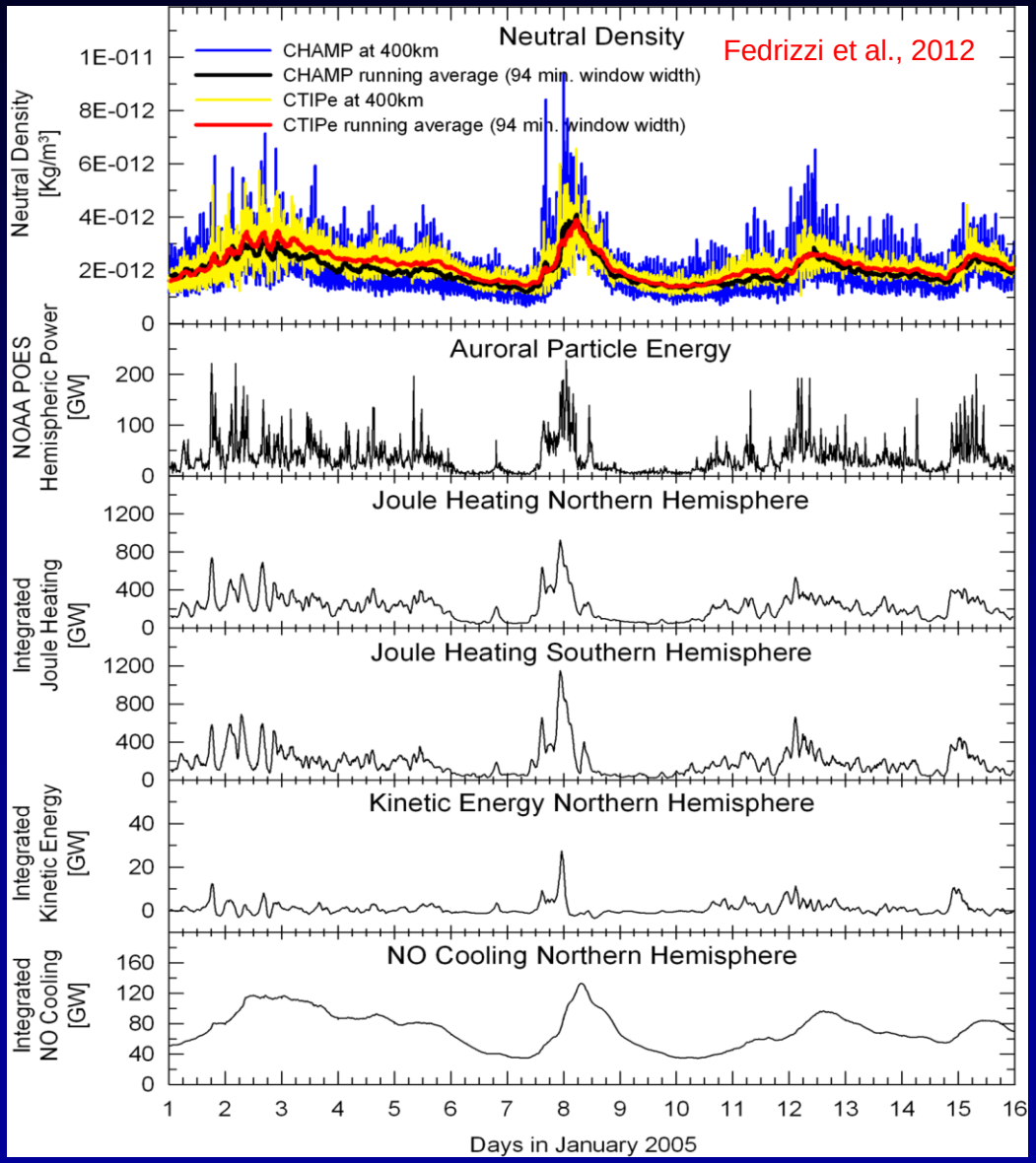
The OVATION Aurora Forecast Model shows the intensity and location of the aurora predicted for the time shown at the top of the map. This probability forecast is based on current solar wind conditions measured at L1, but using a fixed 30-minute delay time between L1 and Earth. A 30-minute delay corresponds to approximately 800 km/s solar wind speed as might be encountered during geomagnetic storming conditions. In reality, delay times vary from less than 30 minutes to an hour or so for

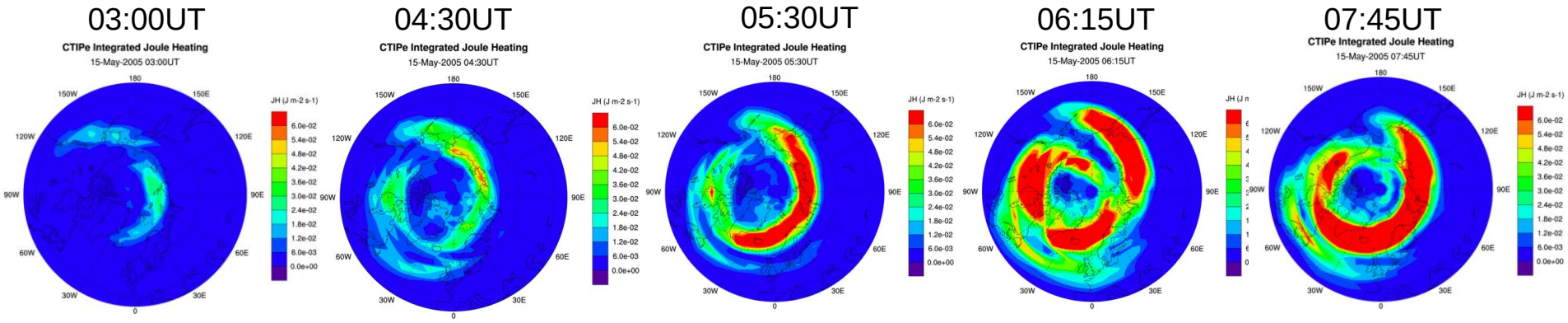
Partitioning of Energy during a Geomagnetic Storm

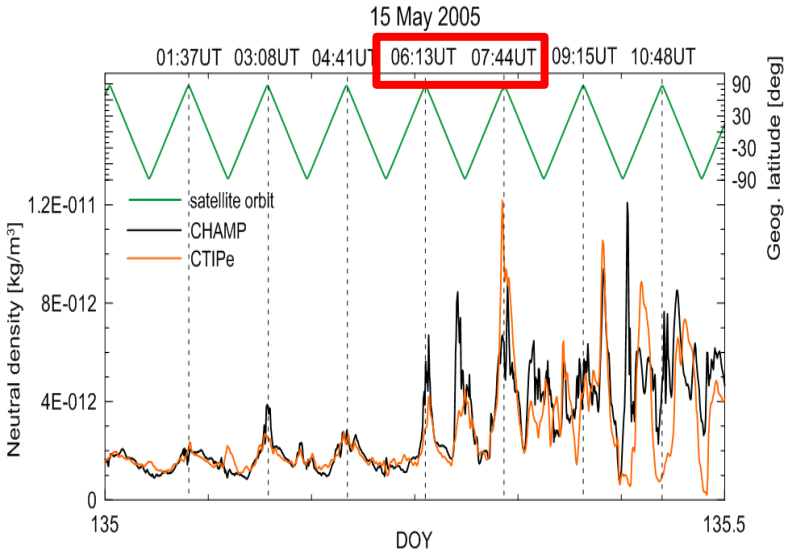


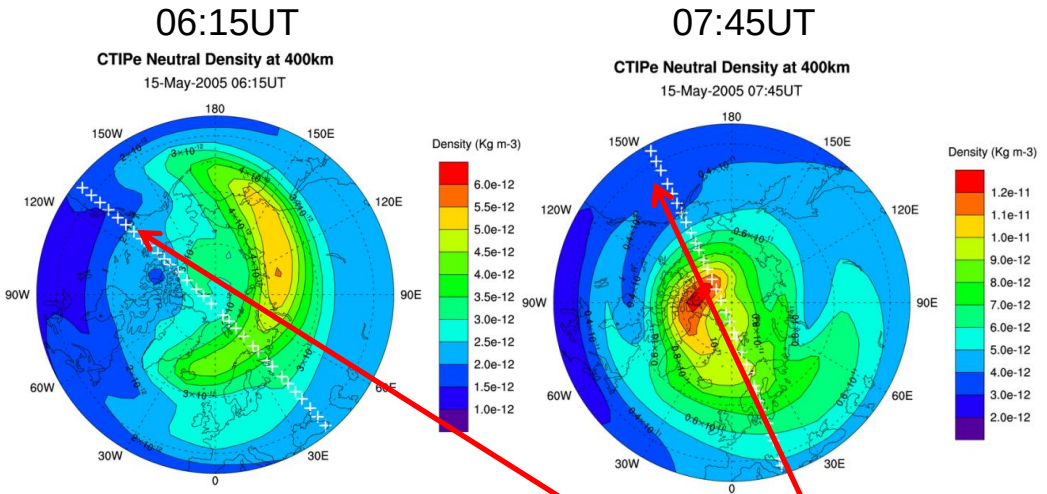
- Integrated Joule heating accounts for the majority of energy input into the ionosphere/thermosphere system during geomagnetic storms (e.g., Lu et al., 1995; Knipp et al., 2004; Fuller-Rowell and Solomon, 2010).

- Auroral precipitation is most effective in increasing the E-region plasma densities, which produces an increase in the peak of the Pedersen conductivity profile around 125 km altitude. A doubling of the plasma density doubles both the conductivity and Joule heating dissipation from the auroral currents, a contribution to the energy budget significantly larger than the particle energy itself (Fuller-Rowell and Solomon, 2010).

15 May 2005 CTIPe Joule Heating Distribution and Neutral Density







Model overestimate/underestimate measurements at times, possibly due to the uncertainty in the magnitude and spatial distributions of the magnetospheric electric field and auroral precipitation.

CHAMP orbit

From Tim:

- **For global models, for aurora alone, we need 2D maps of the energy influx and some knowledge of the spectrum, at ~5 min cadence, and ~100 km horizontal resolution. The rest is done in the models.**

- **What we really need, is the coincident measurements of the electric field/plasma drift and auroral precipitation. It is really their combined effect that we want to capture.**